Atty. Docket: 04-0734

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Steven D. Richardson : Group Art Unit: 3644

Serial No.: 10/711,372 : Examiner: Michener, J.J.

Filed: September 14, 2004

Title: TANDEM ROTOR WING ROTATIONAL POSITION CONTROL SYSTEM

Hon. Commissioner for Patents
Alexandria, VA 22313-1450

RULE 132 DECLARATION

Sir:

I, STEVEN D. RICHARDSON, make the following declaration, pursuant to 37 CFR § 1.132, in opposition to the obviousness rejections set forth in ¶¶ 2-28 of the non-final action mailed on January 30, 2008 in the above-referenced patent application.

I am an employee of the assignee, The Boeing Company, and am the sole inventor of the inventions recited in the pending claims of the above-referenced patent application.

On page 2 of the office action, claims 1-5, 10, 12, 13 and 26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Frank (US 3,515,485) in view of Vertatschitsch *et al.* (US

5,294,075) and Morrison *et al.* (US 4,488,236). On page 4 of the action, claims 6-9 and 11 were rejected as being unpatentable over the same three references and further in view of Engels *et al.* (US 5,205,710). Lastly, on page 5 of the action, claims 3, 18-25, 37 and 38 were rejected as being unpatentable over Bass *et al.* (US 6,789,764) in view of the aforementioned Frank, Morrison and Vertatschitsch patents. I disagree with the grounds of rejection for the following reasons.

US Patent No. 3,515,485 to Frank

Frank describes a rotor blade position measuring device that relies on a projected beam of coherent light. It is exclusively concerned with characterizing the vertical position of the blade disk at the rotor tips, because "a difference in the plane of rotation between one blade and another can create an unbalance in the helicopter rotor system which gives rise to undesirable vibration" [Frank, col. 1, ll. 53-56]. It then goes on to describe blade tracking, which means the vertical position of each rotor blade's tip as it passes a reference point. "When all of the blades rotate in a preselected plane of rotation or at the same distance from an established plane of reference, they are all said to be 'in track'" [Frank, col. 1, ll. 63-65]. The patent is

careful to define these terms: "It is to be understood that the plane of rotation of the blades, as used in the specification and claims, is intended to refer to the plane described by a point on the whirling blades, such as the tip of the blades" [Frank, col. 1, ll. 48-52]. Therefore the measuring system described by the Frank patent is only being used to measure blade tracking, which means the vertical dimension of the rotor disk's rotation. This is confirmed in the Frank patent's stated purpose: "a system is provided for indicating the vertical displacement of the plane of rotation of a blade from an optimum plane of reference" [Frank, col. 5, ll. 19-21]. Although the Frank patent talks about angular displacement of blades, that is only in connection with calculating algorithms to compute vertical blade position data.

The Applicant's invention uses optical (or other) devices to sense blade motion, but in this case the measurement is of angular positions of blades around the circle of their revolution, not their vertical dimension at all. The purpose of such measurement has nothing to do with blade tracking but with ensuring that a safe separation is maintained between the overlapping rotor disks of tandem-rotor aircraft configurations. This purpose would not have been anticipated by any prior art and

certainly not by the Frank patent, because all tandem-rotor vehicles ever built have had their rotors mechanically connected by driveshafts and gearboxes to positively prevent any possibility of rotors straying out of synchronization. For example, in discussing the use of phase detector means, Frank states: "even [on] a tandem rotor helicopter only one phase detector means for the tracking system is required, since the blades of the fore and aft rotor always maintain the same relationship with respect to one another" [Frank, col. 8, ll. 53-57]. In contrast, Applicant's invention opens the door to aircraft configurations that need not carry the weight and complexity of components for mechanically connecting the rotors by providing means for adjusting the variable relationship of rotors not mechanically linked to each other.

US Patent No. 5,294,075 to Vertatschitsch

Vertatschitsch describes a way of measuring positions of rotating machinery such as helicopter rotors using electro-optical sensors. This is basically similar to the "detector" part of the subject patent application. But the prior patent only speaks vaguely about passing this data along to a flight controller; the heart of the subject patent application revolves around what is

done with that data, i.e., to continuously control the positions of the rotors, not just measure those positions.

US Patent No. 4,488,236 to Morrison

Morrison provides a way to increase the fuel-burning efficiency of rotorcraft by measuring various parameters and controlling rotor speed accordingly. Only the sub-case of multiple-rotor aircraft is applicable with regard to comparisons with the subject patent application. It is crucial to understand that controlling the rotor speed by any means, including those disclosed in the Morrison patent, for every multi-rotor aircraft ever built, automatically means controlling both rotors to the same speed because they are mechanically connected by driveshafts and gearboxes so that there is no possibility of the rotors turning at different speeds or especially, in the case where the rotors overlap one another, of the blades being at points along their rotation where they could collide with disastrous consequences. The subject invention, by contrast, uses a combination of blade position sensing along with "tweaking" of each rotor's rotational position via small applications of either additional drive or slight braking. This ensures that the required relative positions of blades in each rotor can be maintained

safely, but it allows the cross-shafting hardware to be removed altogether.

US Patent No. 6,789,764 to Bass

Bass describes a stoppable-rotor aircraft having two rotors, but as stated in column 8, lines 7-9, the rotors inherently rely on cross-shafting in order to stay in phase, so that their blades can never come into contact with one another. The subject patent application maintains safe rotor positions in an entirely different way, through active management of each rotor's rotational position separately rather than by locking them together mechanically. The Bass cross-shafting system was well-known when the subject patent application was filed, and the elimination of the weight and complexity of this cross-shafting was a major object of the present invention. This was accomplished by providing means for actively monitoring and controlling the positions of blades in each rotor, something that the Bass patent did not contemplate.

US Patent No. 5,205,710 to Engels

Engels describes an optical sensor that feeds a signal to an airframe-mounted device for the purpose of detecting cracks in a helicopter blade, not detecting blade position. There are

many ways to accomplish a sensing function; what matters about the subject patent application is what is done with the blade positional information. Positional data is not disclosed or suggested in the Engels patent.

Summary

Overall the Examiner contends that "It would have been obvious for one of ordinary skill in the art to apply the technique of coupling position detectors to a flight detector as taught in Vertatschitsch, to improve the helicopter of Frank for the predictable result of enabling a flight controller to make the appropriate adjustments in response to position signals for the flight of the helicopter encompassing adjusting the speeds of the rotors to minimize fuel consumption as taught by Morrison." He goes on to say that the use of flight controllers in general is well known, including their use to change RPMs of rotors, and that out-of-track conditions can be monitored and mitigated via adjustments in rotor speed. As discussed above, it is important to understand that "out of track" refers to a measurement of deviation in a vertical plane, while the subject patent has no interest in that; instead it is concerned with monitoring and controlling blade angular positions in the circle of rotation,

which is a completely different type of measurement. And "adjusting the speeds of the rotors" in Morrison as well as in every multiple-rotor helicopter in existence implicitly means adjusting the speed of both rotors at once; this is so because all such aircraft have cross-shafting that rigidly ties their rotations together, whereas the whole purpose of the Applicant's invention is to sever that tie and to adjust the rotational speed of one or more rotors that are not mechanically linked to each other, which, to the best of my knowledge, lies outside anything that has ever been tried before. The advantage for doing so is the elimination of a great mass of shafts and gearboxes, which will translate into improved payload and overall operational efficiency.

To reiterate, the fact that the proposed new way of managing multiple rotors is not "obvious for one of ordinary skill" is that it has never been described, designed, or built in the 60 years of modern tandem-rotor aircraft. All multi-rotor aircraft that have overlapping rotors use mechanical devices to lock the rotation of those rotors together; the proposed invention needs no such devices, and that is what makes it unique.

I hereby declare that all statements made herein of my own

knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor: Steven D. Richardson

Inventor's signature: Steven D. Richardson 2/25/08
DATE

Atty. Docket: 04-0734

CERTIFICATE OF MAILING

The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date set forth below.

March 3, 2008
Date

Dennis M. Flaherty